DOCUMENT RESUME

ED 393 697 SE 058 250

AUTHOR Brown, Fletcher S.
TITLE The Effect of an Inquiry-Oriented Environmental Science Course on Preservice Elementary Teachers' Attitudes about Science.
PUB DATE Apr 96
NOTE 12p.; Paper presented at the Annual Meeting of the National Association for Research in Science Teaching (69th, St. Louis, MO, April, 1996).
PUB TYPE Reports - Research/Technical (143) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Elementary Education; *Elementary School Science; *Elementary School Teachers; *Environmental Education; Higher Education; *Inquiry; *Preservice Teacher Education; *Teacher Attitudes
IDENTIFIERS Learning Cycle Teaching Method; Preservice Teachers

ABSTRACT

The purpose of this study was to assess a model inquiry-oriented environmental science course offered to preservice elementary education majors at the University of Montana in order to investigate the effects of environmental science classes on preservice elementary education majors. The guiding questions for the study (N=125) were: What learning environment profile reflects an inquiry-oriented environmental science classroom? and Are students' attitudes about science affected by the environmental science course taken? Data collection instruments included the Science Laboratory Environment Inventory (SLEI) and the Test of Science Related Attitudes (TOSRA). Results indicate that the course provided adequate laboratory materials and students interacted with each other in a positive manner. The results from the TOSRA questionnaire suggest that exposure to an inquiry-oriented environmental science course could promote at least short-term change regarding student attitudes involving social change. Another finding was that students had more positive attitudes about inquiry as a process in science after being exposed to a learning cycle-based course. It was concluded that results from this study support the recommendation that preservice elementary teachers take course work in environmental science or environmental education. Contains 12 references. (JRH)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED 393 697

THE EFFECT OF AN INQUIRY-ORIENTED ENVIRONMENTAL SCIENCE COURSE ON PRESERVICE ELEMENTARY TEACHERS' ATTITUDES ABOUT SCIENCE.

Fletcher S. Brown,
University of Montana
Missoula, MT 59812

PERMISSION TO REPRODUCE AND DISSEMINATE THIS MATERIAL HAS BEEN GRANTED BY

F. Brown

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

Paper Presented at the annual meeting of
The National Association for Research in Science Teaching
St. Louis, Missouri April, 1996

BEST COPY AVAILABLE

Over the last decade environmental education has grown in importance in many preservice teacher education programs. An increased awareness of environmental problems such as population growth and environmental degradation has led some states to establish statutory requirements that elementary teachers have competencies in their understanding and teaching about the environment (Engleson, 1986). One response to the interest in preservice environmental education has been the development of programs which help prepare prospective teachers to more effectively learn about and teach environmental education. Examples of such programs include the Teacher Education Program (Marcinkowski, 1990) and Empowerment through Cognitive and Social Management (Gunzenhauser, 1994). Internationally their has also been a growing recognition of the importance that elementary teachers gain further understanding and skills in teaching about the environment (Tilbury, 1992).

While more teacher education programs require preservice teachers to take environmental education or environmental science courses, it is still unclear what effect these courses have on prospective teachers' attitudes and future teaching practices (Tilbury, 1992). Koballa and Chen (1993) found there to be some short and long-term changes in elementary education students' intention and attitudinal beliefs about the environment using anecdotal messages, however, they found no short or long-term changes in intention or attitudes using data-summary messages. Yount and Horton (1992) reported no significant changes in non-science majors environmental attitudes but did see change in environmental attitude decision making especially among those with higher cognitive reasoning skills. McClure and Bell (1990) used concept maps as an assessment tool and reported some change in preservice students' proposition characteristics after completing an environmental education course. Still unanswered in these and other studies are questions regarding what characterizes an exemplar environmental science classroom and whether these courses can change preservice teachers' attitudes and teaching practices about the environment.

To further investigate the effects of environmental science classes on preservice elementary education majors, a model inquiry-oriented environmental science course offered to preservice elementary education majors was assessed at the University of

Montana. The guiding questions for the study were: What learning environment profile reflects an inquiry-oriented environmental science classroom? Are students' attitudes about science affected by the environmental science course taken?

Methods

Research Design

This study used a one-group pretest-post test design. The subjects studied were preservice elementary education majors (n=125) taking a required course in environmental science (see experimental course description in the treatment section). To help characterize the classroom learning environment the learning environments questionnaire entitled the Science Laboratory Environment Inventory (SLEI) was used. The actual form of the SLEI was given to all students in the environmental science course midway through the semester, and classroom observations were made throughout the semester for comparison and reliability. To assess changes in student attitudes about science the Test of Science Related Attitudes (TOSRA) was chosen. The TOSRA questionnaire was given to students at the beginning and end of the environmental science course to measure changes in student attitudes after exposure to the inquiry-oriented environmental science learning environment.

Treatment

Experimental Course

The environmental science course assessed was developed and taught at the University of Montana with support from the National Science Foundation funded grant entitled The Systemic Teacher Excellence Preparation Project (STEP). The course structure incorporated two major conceptual frameworks for instruction. One was the 5-E's learning cycle (Trowbridge & Bybee, 1990) and the other was a model for teaching environmental education which incorporated understanding ecological concepts, values clarification, and personal action projects involving a local environmental problem (Van Matre, 1990). A series of learning cycles began the course focusing on human resources. Each cycle started with an engagement activity which led students to a series of questions they followed in the laboratory. In the laboratory the questions were explored and discussed giving students experiences with the concepts being

investigated. Upon returning to the lecture, students were asked to share the results of their explorations. Students were encouraged to ask questions and the instructor introduced and applied terms regarding the concepts investigated. At this point students returned to the laboratory and participated in discussions about humans impact regarding the resource explored. Instructors guided students in identifying the various positions and values which influence human use and impact of the resource. This was the elaboration portion of the learning cycle as well as the values clarification portion of the environmental education teaching model. The goals of the elaboration and values clarification activity was to reinforce the concepts explored and apply them in a meaningful context.

Five different learning cycles occurred as described above involving the resources of water, biodiversity, air, and minerals/toxic substances. After giving students the opportunity to build conceptual understandings about the environment (exploration and explanation portions of the learning cycle) and identify factors which influence humans use of the resources (elaboration portion of the learning cycle and values clarification of the environmental education teaching model), students were given an opportunity to get involved in an local environmental problem. Each student participated in a collaborative action group team which selected a local or regional environmental issue and studied the issue in both scientific and social contexts. Students developed skills in action strategies and critical thinking which led to proposed solutions to the issue studied. Students then became actively involved in the implementation of these proposed solutions. As the action group projects occurred in the laboratory, the instructor and students participated in related classroom discussions involving the social/political components in environmental science. Topics discussed involve population dynamics and control, religion and ethics, economics and politics, and environmental education. At the end of the course, students completed and turned in a portfolio about their class activities and presented their action group projects to the class.

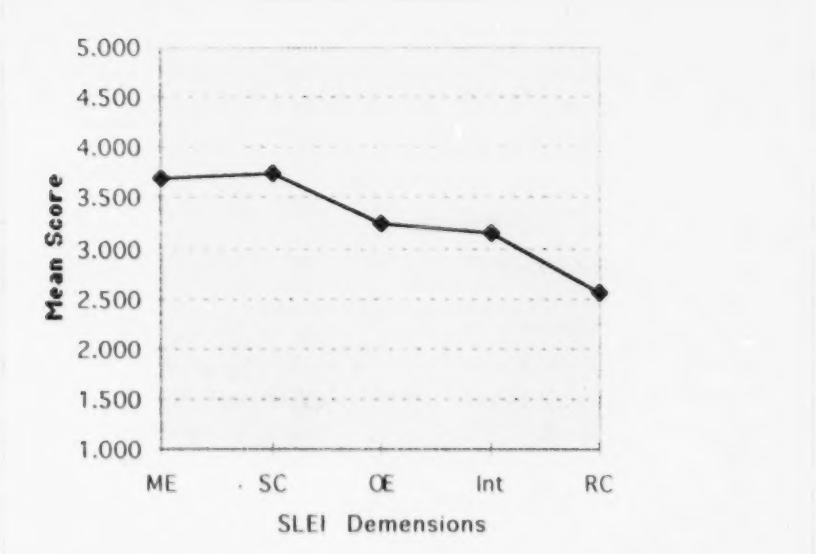
Results

SLEI Data

During the twelfth week of the sixteen week semester course the actual form of the SLEI was given to all students taking the environmental science course. This questionnaire asked students to answer questions related to what they actually experienced in their science laboratory learning environment (Fraser, 1995). Questions on the SLEI instrument are divided into five scales: Material Environment (ME), Student Cohesiveness (SC), Open-endedness (OE), Integration (IN), and Rule Clarity (RC). Figure 1 shows the results of the mid-term responses to the actual form of the SLEI.

Figure 1

Scale Means for the Actual Form of the SLEI



Control and experimental group mean scores are based on a five-point Likert-type scale, ranging from 'almost never' to 'very often'. For example, if students' viewed their laboratory class as having mostly open-ended activities, the score recorded would be a 5. If students' viewed their laboratory class as having few open-ended activities, the score recorded would be a 1. The profile in Figure 1 are mean scores at

the class level for preservice elementary students participating in the environmental science course being studied.

TOSRA Data

During the first and last week of the spring semester all students enrolled in the environmental science course being studied were asked to complete the Test of Science Related Attitudes (TOSRA) questionnaire. This multiple choice test contains 70 questions that are divided into six categories: social implications of science, normality of scientists, attitudes to scientific inquiry, adoption of science attitudes, enjoyment of science lessons, leisure interests in science, and career interest in science. The test uses a five-point, Likert-type scale ranges from 'strongly agree' to 'strongly disagree' (Fraser, 1981).

Table 1 shows the comparison of the pretest and post test mean scores for the seven scales of the TOSRA Questionnaire

Table 1

Scales	Pretest	Posttest	*P*
Social Implications	35.53(7.11)	39.01(5.86)	0.004
Normality	37.38(4.82)	37.10(6.01)	0.785
Inquiry	36.63(6.46)	38.79(6.35)	0.053
Science Attitudes	38.22(5.31)	38.86(5.16)	0.513
Enjoyment	37.31(7.18)	37.72(6.82)	0.751
Leisure Interests	31.67(7.66)	31.45(7.45)	0.873
Career Interest	29.05(6.72)	30.45 (7.01)	0.276

Note. SD in parentheses.

Results from the TOSRA questionnaire showed a significant positive change in students' mean scores regarding the category of social implications of science and attitudes to scientific inquiry. These were the only categories that showed a significant change at an alpha level $\leq .05$.

Discussion

What learning environment profile reflects an inquiry-oriented environmental science classroom?

Results from the actual form of the SLEI show positive responses on all dimensions of the questionnaire except for rule clarity (See Figure 1). The two dimensions of material environment and student cohesiveness had the highest mean scores indicating that the course provided adequate laboratory materials and students interacted with each other in a positive manor. This matches well with observational data which indicated students often worked in cooperative groups involving problem solving activities and laboratory experiments. Low student scores on the dimension of rule clarity were similar to previous studies using the SLEI questionnaire in inquiry oriented learning environments (Brown, 1994). In inquiry learning environments, students are frequently asked to develop their own approaches to answering questions and not given specific directions or procedures. Low rule clarity scores were reported for students not familiar with this type of learning environment. Preservice teachers taking this inquiry-oriented environmental science course were unfamiliar with this instructional approach and had similar low rule clarity scores. The profile in Figure 1 provides a snapshot of what this inquiry environmental classroom looked like. It can be viewed as a learning environment where there were open-ended activities, student interaction, good laboratory equipment, an integration between the lecture and laboratory learning environment, and a limited number of rules were given to students to follow when investigating questions in environmental science.

Are students' attitudes about science affected by the environmental science course taken?

Results from student responses on the TOSRA questionnaire show significant positive mean score gains on preservice students' attitudes regarding the social

benefits and problems which accompany scientific progress and attitudes to scientific inquiry . The mean score gains in social implications of science matched well with the aims of the course which attempted to move students from understanding and values clarification toward social action and application of their understanding. Van Matre argues that for students and teachers to truly become environmentally conscious they must take social action regarding their own beliefs about the environment (Van Matre, 1990). These results suggest exposure to an inquiry-oriented environmental science course could promote at least short-term change regarding student attitudes involving social change.

Mean score gains in the scale of attitudes to scientific inquiry indicated students, after exposed to a learning cycle-based course, have more positive attitudes about inquiry as a process in science. This is encouraging considering the national reform efforts advocating the use of inquiry as a method for teaching in math and science classrooms. This course is just one in a series of science courses taken by preservice elementary education majors at the University of Montana which use inquiry as a method of instruction. By consistently exposing students to inquiry learning environments in science and math, it is hoped that these positive gains in attitudes could impact their own classrooms teaching practices involving inquiry.

Results from this study support the recommendation that preservice elementary teachers take course work in environment science or environmental education given the model assessed in this study. This instructional model was composed of inquiry-based understanding of ecological concepts, values clarification, and action group projects. It can be further characterized using the science laboratory environment inventory as an open-ended learning environment, composed of a high degree of student interaction, a close connection existed between the lecture and laboratory activities, and rules in the class were fewer and less clear. Preservice student attitudinal outcomes from this learning environment showed gains involving the social implications of science and scientific inquiry. These outcomes match goals set by environmental educators which advocate positive attitudes toward social change and science education reform goals which promote inquiry instruction. It should be noted that data collection in this study was limited to three college semesters in length and assessed only short-term attitudinal outcomes. Future studies will include assessment

of students beyond their preservice teacher education training and into their classroom to see if there is long-term effects regarding teachers' attitudes and teaching practices about environment topics and inquiry instruction.

References

Brown, F.B. (1995, April). The Effect of inquiry Instruction on Undergraduate Biology Students' Perceptions of Their Science Laboratory Learning Environment. Paper presented at the meeting of the National Association of Research in Science Teaching, San Francisco, CA.

Engleson, D.C. (1986). Recent Wisconsin initiatives in environmental education. Paper presented at the Annual Meeting of the North American Association for Environmental Education, Eugene, OR.

Fraser, B. J. (1981). Test of science-related attitudes. Melbourne: Australian: Council for Educational Research.

Fraser, B.J., Giddings, G.J. & McRobbie, C.J. (1995). Evolution and validation of a personal form of an instrument for assessing science laboratory classroom environments. Journal of Research in Science Teaching. 32(4), 399-422.

Gunzenhauser, G.W. (1994). INTASC's model standards for beginning teacher licensing and development: one model for teacher preparation programming. (Report No. SP035046). Illinois: Western Illinois University. (ERIC Document Reproduction Service No. ED 362 487)

Koballa, T.R. & Chen, C.S. (1993). Influencing chinese prospective elementary teachers' decisions to teach about the environment. Journal of Elementary Science Education. 5(1), 27-49.

Marcinkowski, T.J. (1990). An environmental education approach to training of middle level teachers: a prototype programme. environmental education series 30. United Nations Educational, Scientific, and Cultural Organization, Paris, France.

McClure, J.R., & Bell, P.E. (1990). Effects of an environmental education-related STS approach instruction on cognitive structures of preservice science teachers. (Tech Rep. No. 143). Pennsylvania State University, University Park College of Education.

Tilbury, D. (1992). Environmental education within pre-service teacher education: the priority of priorities. International Journal of Environmental Education and Information, 11(4), 267-80.

Trowbridge, L.W., & Bybee, R.W. (1990). Becoming a secondary school science teacher (5th ed.). Columbus, Ohio: Merril Publishing Company

Van Matre, S. (1990). Environmental education.... mission gone astray. In S. Van Matre (Eds.), Earth Education (pp. 1-47). Warrenville, Ill. : The Institute for Earth Education

Yount, J.R., & Horton, P. B. (1992). Factors influencing environmental attitude: the relationship between environmental attitude defensibility and cognitive reasoning level. Journal of Research in Science Teaching, 29(10), 1059-1078.